

# GNP-based sandwich immunosensor for SERS biomarker detection in liquid

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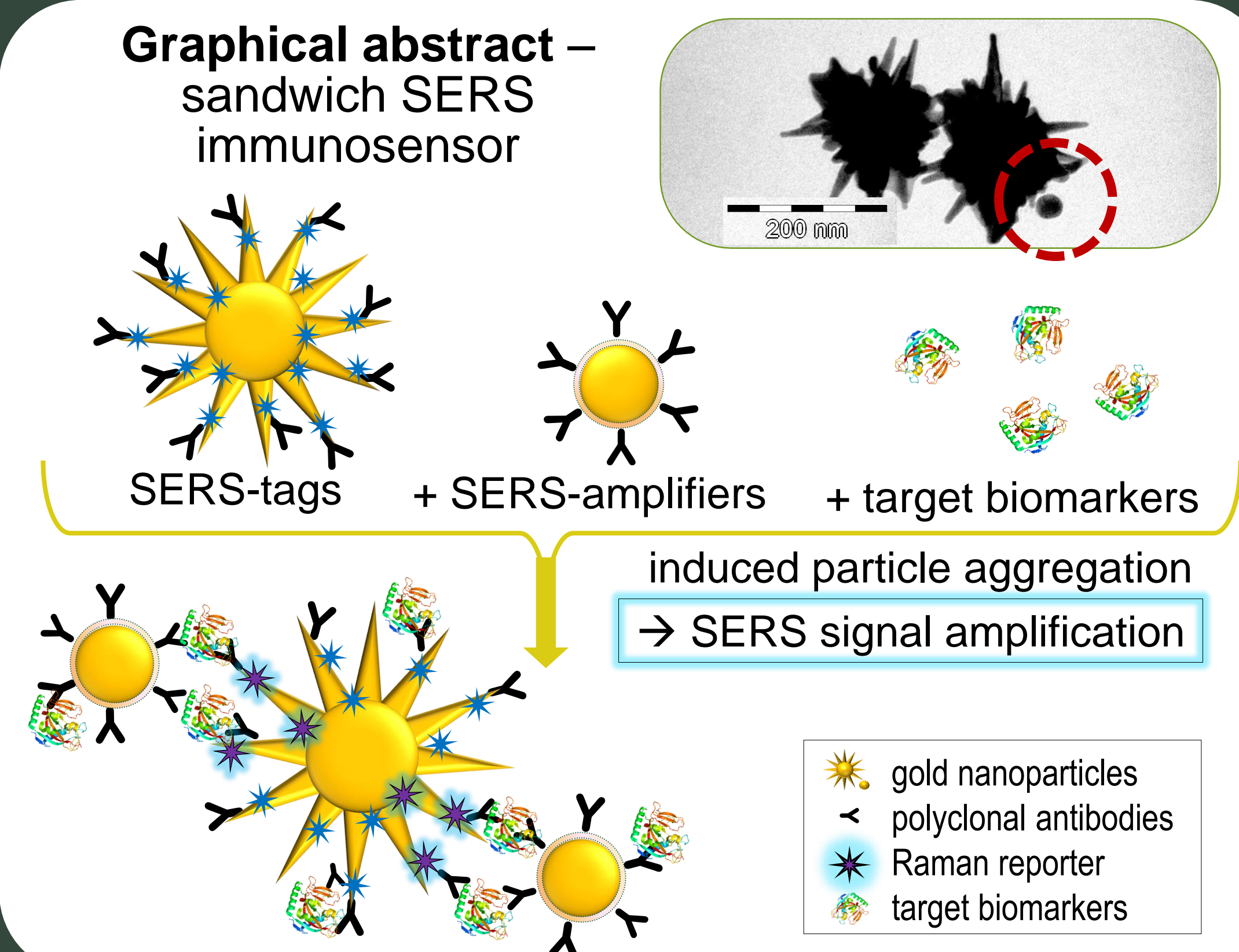


Gold nanoparticle (GNP)-based immunosensors represent a class of promising sensing tools. By combining the capability for biofunctionalisation with the exceptional properties of GNPs, sensitive detection of bio-relevant molecules can be rapidly and cost-effectively achieved. Herein we propose a **Surface Enhanced Raman Scattering (SERS) immunosensor** for detecting and quantifying model biomarker proteins. **Spherical (GNSs) and urchin-like (GNUs) gold nanoparticles** were spectroscopically labelled, PEG-coated, and functionalized with **capturing antibodies**. In the presence of the target antigen (Carcino Embryonic Antigen protein – CEA; Epidermal Growth Factor Receptor – EGFR), **GNP pairs are formed** and the amplification of the label molecule signal is observed *via* **hot-spots formation in interparticle gaps**.

## ABSTRACT

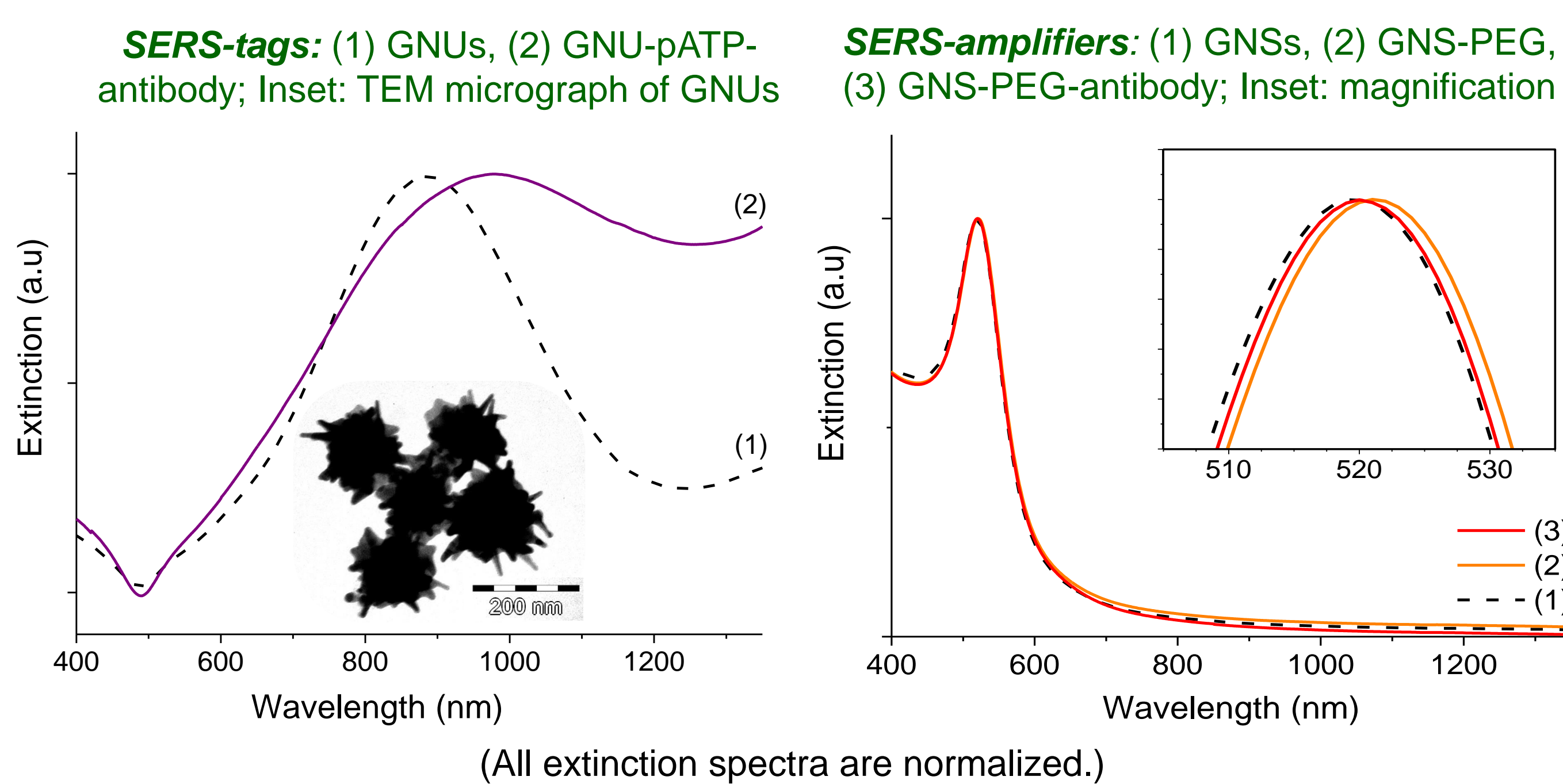
Two different sensing configurations: pairs of GNUs-GNUs and GNUs-GNSs were experimentally tested and **theoretically modelled by FDTD**. Tracking down small analyte concentrations *via* SERS with an easy-to-handle, portable Raman device in tandem with the capacity for **in-liquid detection** makes the proposed system **feasible as a point-of-care assay**.

## Graphical abstract – sandwich SERS immunosensor

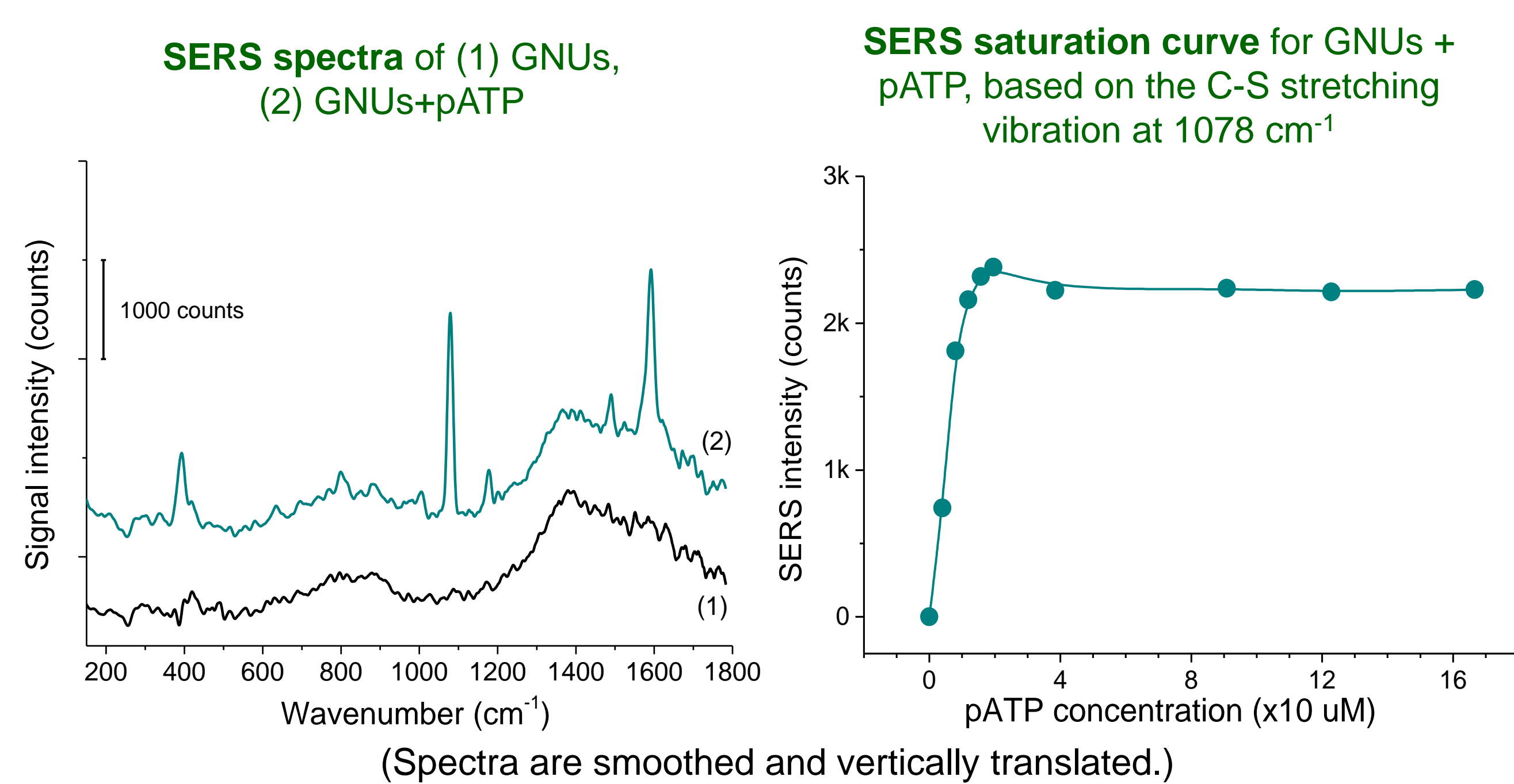


## RESULTS

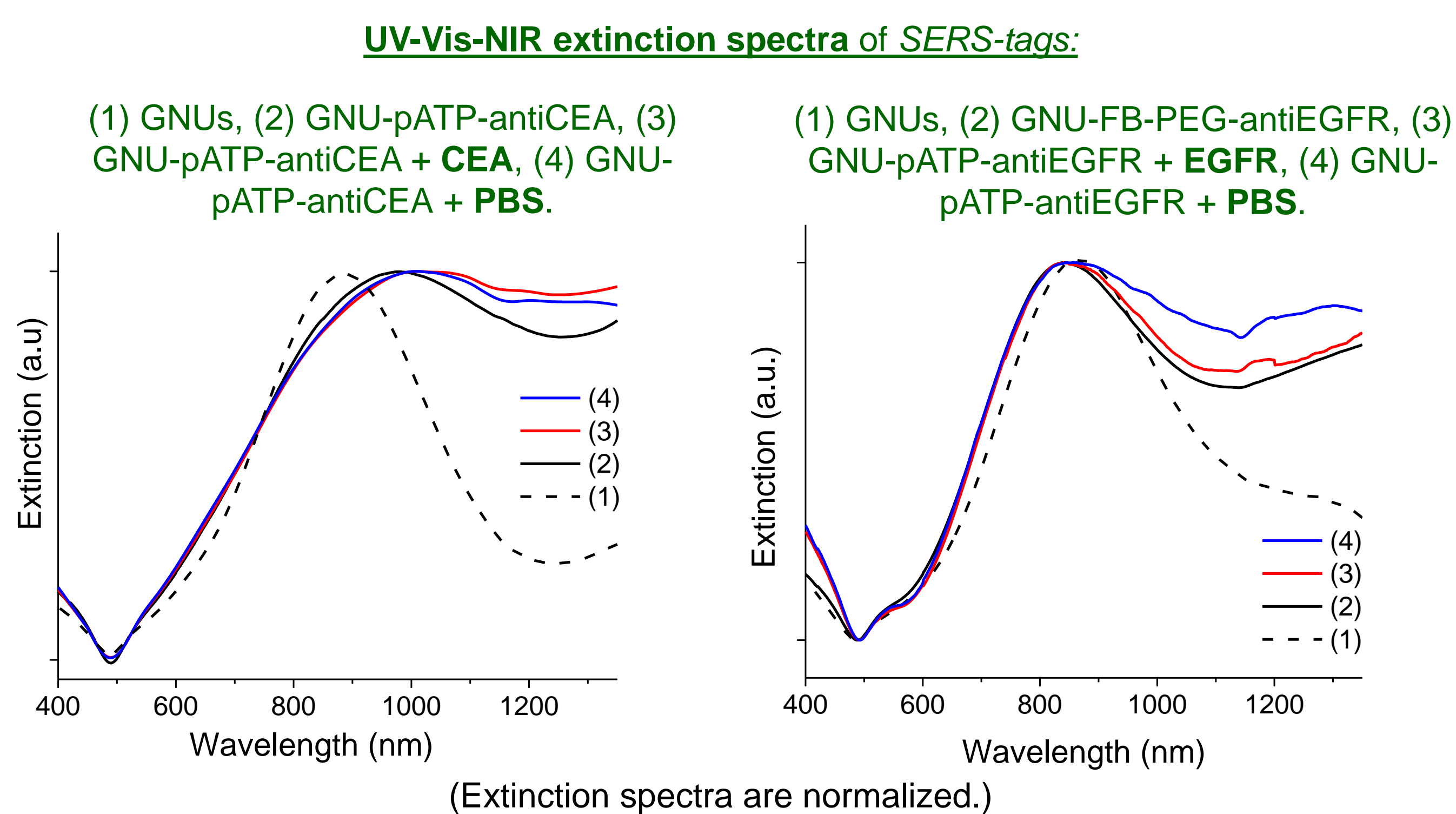
### Nanoparticle functionalization – UV-Vis-NIR extinction spectra



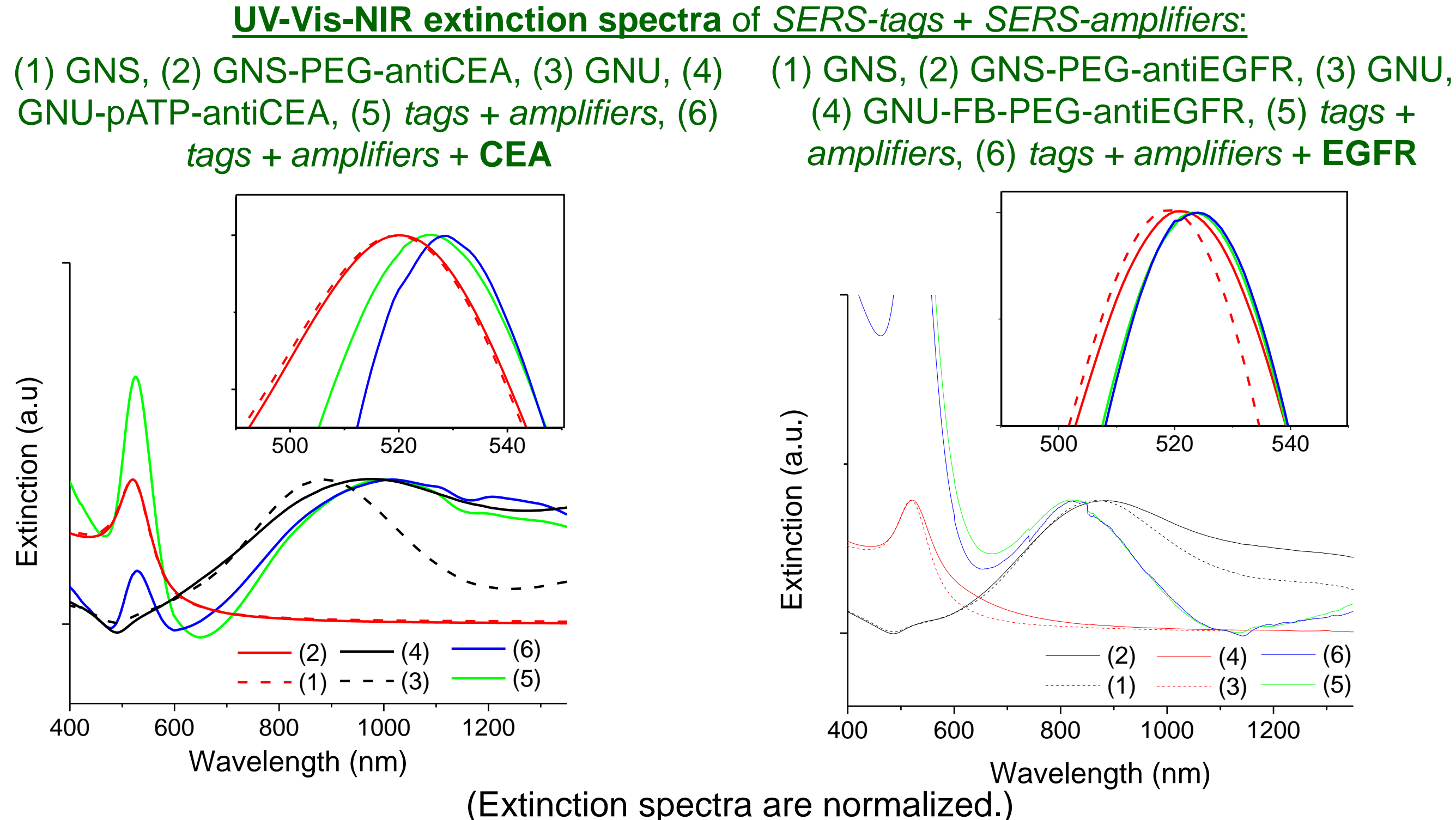
### SERS characterization of GNUs



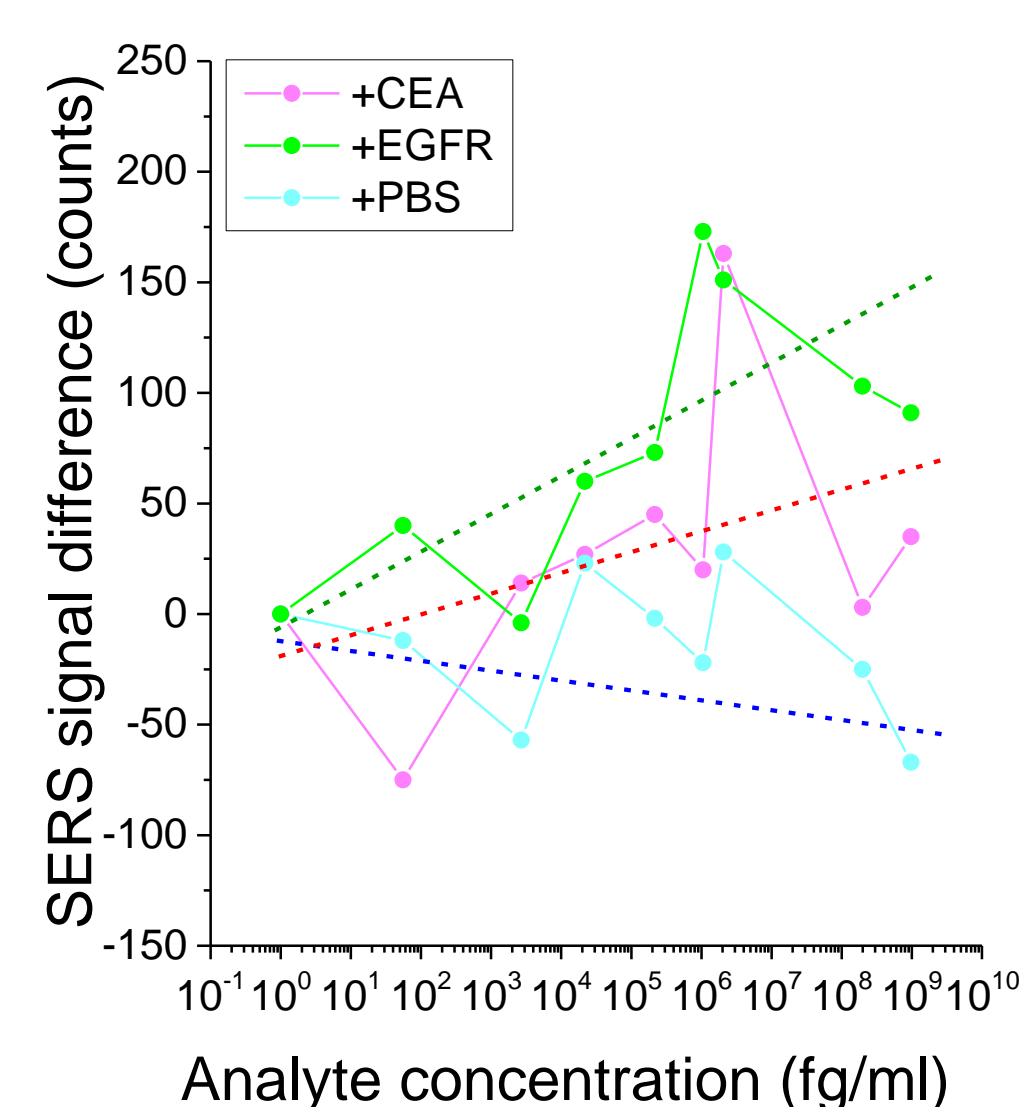
### SERS immunosensor properties: GNU-GNU configuration



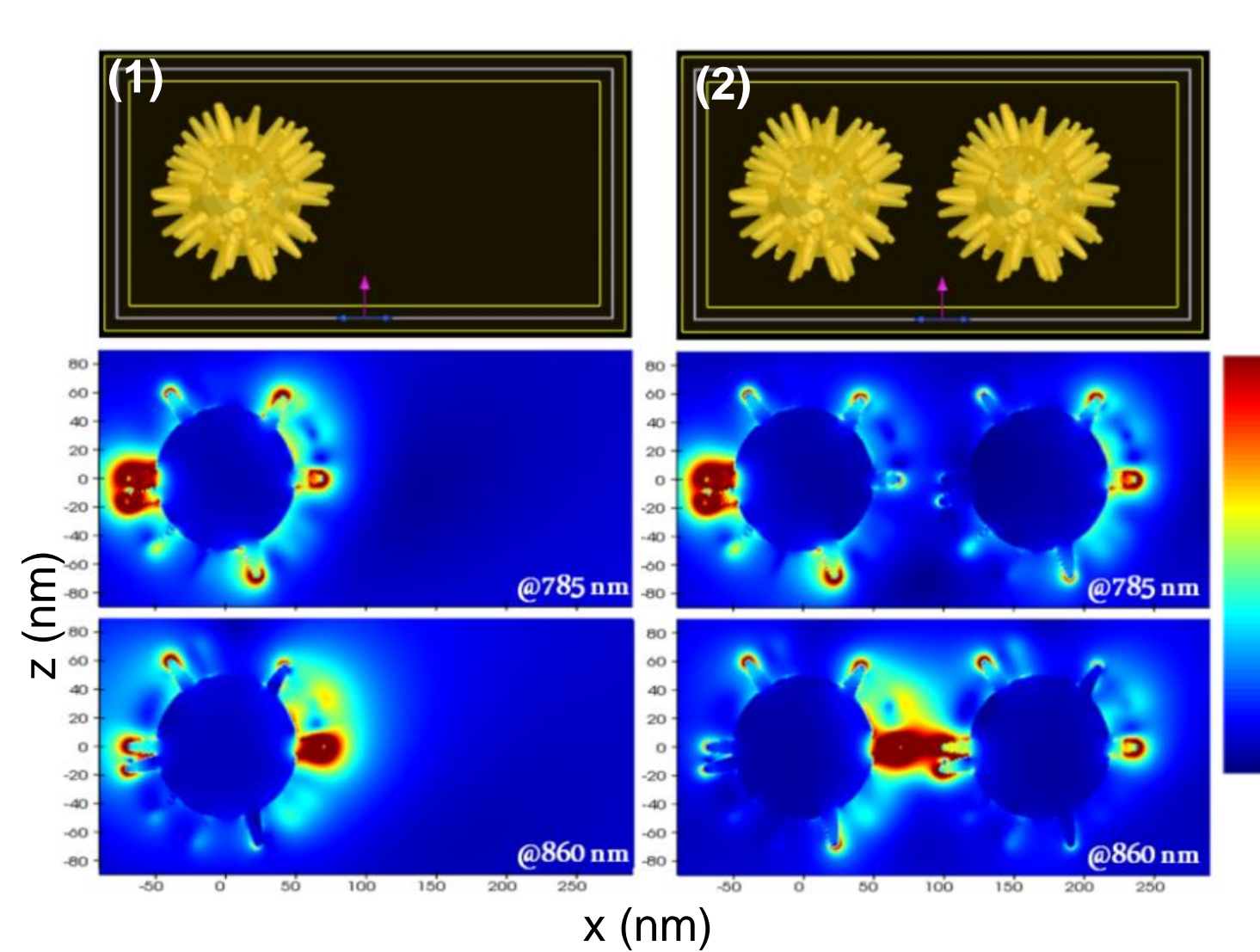
### SERS immunosensor properties: GNU-GNS configuration



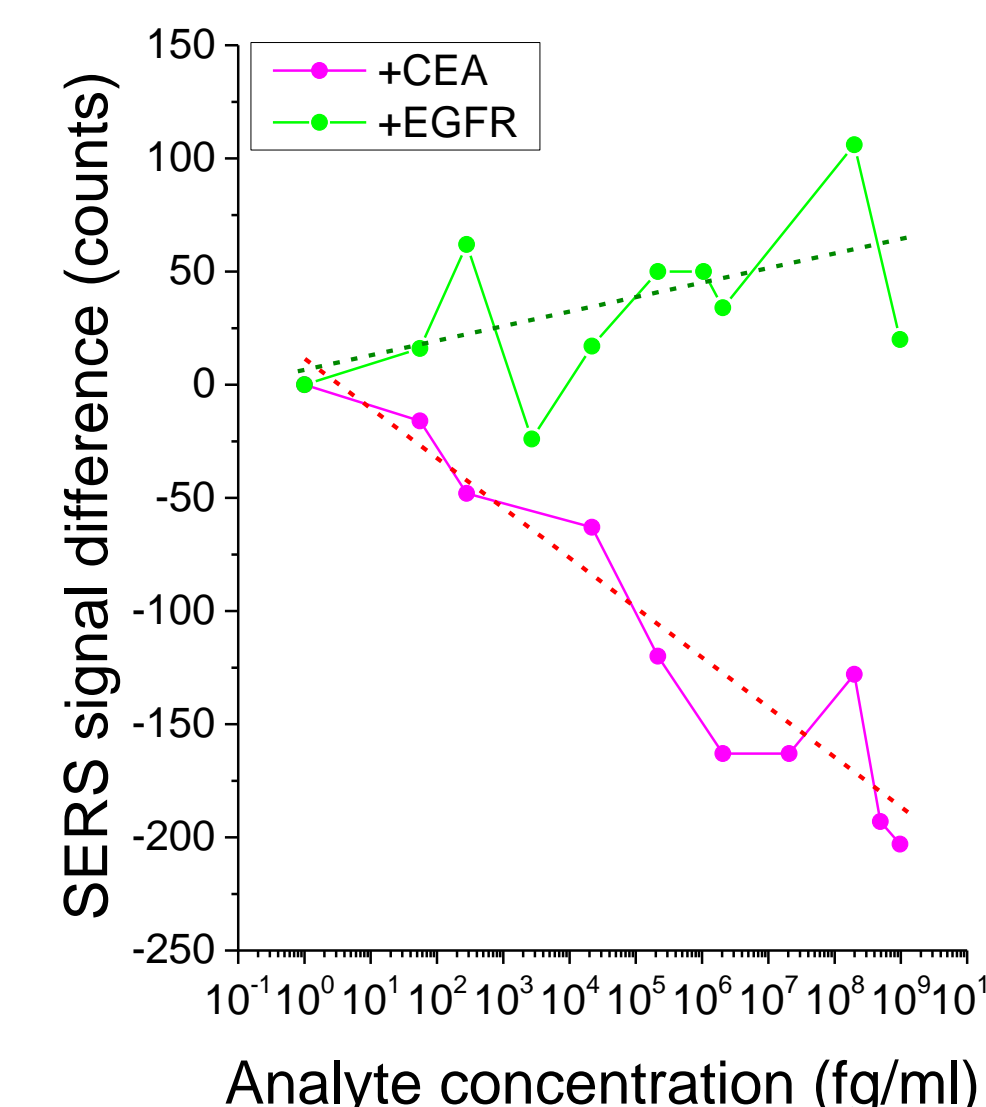
### SERS intensity dependence on CEA and EGFR concentration, and in PBS (control)



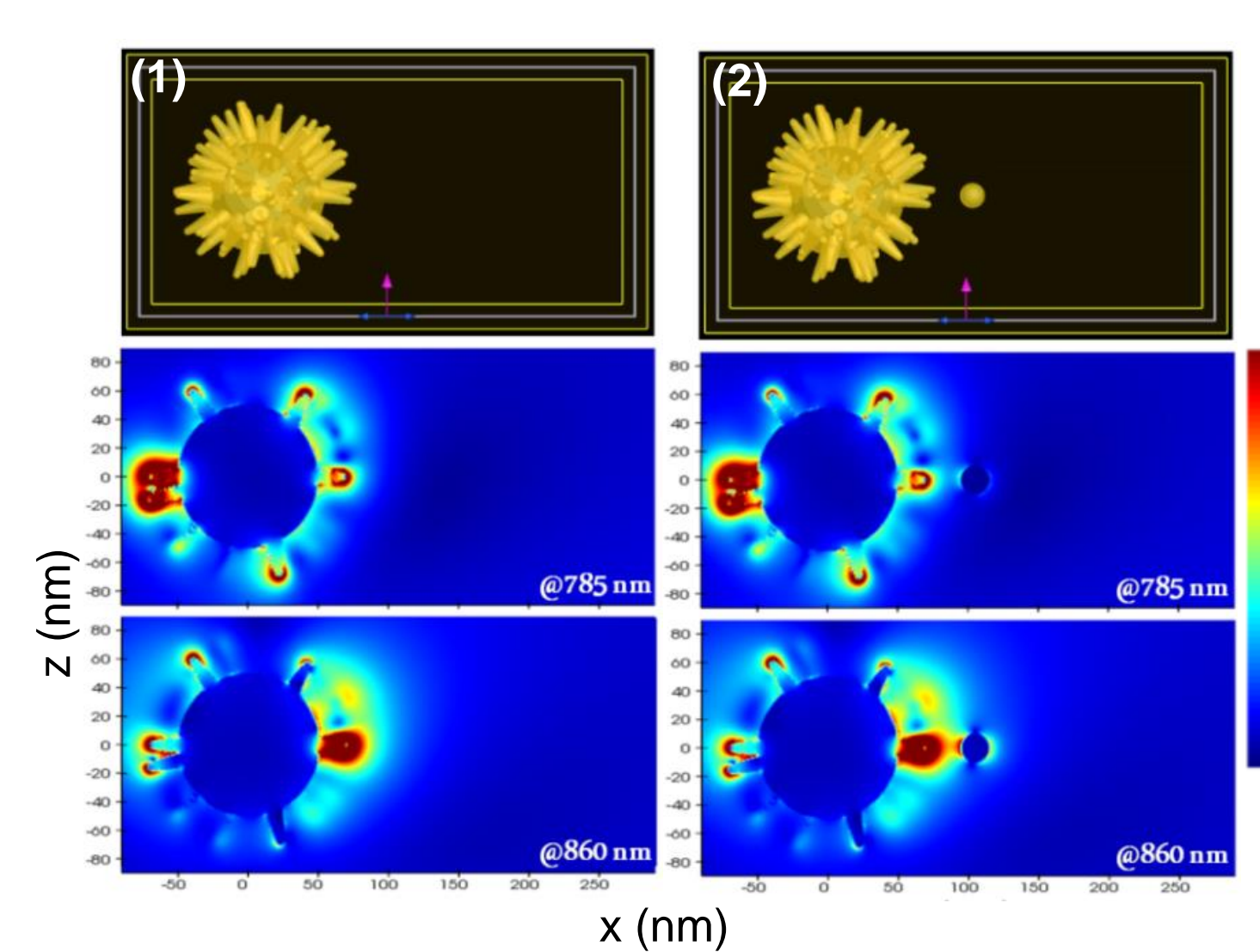
### Electric field maps at 785 nm and 860 nm near a single GNU (1), and a GNU-GNU dimer (2)



### SERS intensity dependence on CEA and EGFR concentration



### Electric field maps at 785 nm and 860 nm near a single GNU (1), and a GNU-GNS dimer (2)



## CONCLUSIONS

- ✓ we developed **GNU-based SERS-tags (GNU-reporter-antibody)** and **GNS-based SERS-amplifiers (GNS-antibody)**.
- ✓ we explored the **detection** of the CEA and EGFR biomarkers as **proof-of-concept**.
- ✓ **GNU-GNU pairs** proved most promising for SERS detection (based on **experimental observations + theoretical FDTD simulations**).
- ✓ we demonstrated antigen detection and measurement in **real-time** with a **portable, easy-to-handle** device.
- ✓ this is a promising approach as **point-of-care assays** for clinically **relevant biomarkers** from fluid samples.

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